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THE RELATIONSHIP BETWEEN TROPICAL PRECIPITATION BIASES AND THE SAHARAN HEAT LOW BIAS IN CMIP5 MODELS

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Résumé :

Representing the West African Monsoon (WAM) is a major challenge in climate modeling because of the complex interaction between local and large scale mechanisms. Comparison of the Saharan heat low (SHL) representation in both CMIP5 simulations and reanalyses shows large biases in the strength and location of the climatological SHL. Both coupled and uncoupled climate models that place the SHL farther to the north are associated with increased precipitation across the Sahel. Further, the northward SHL placement is also associated with a northward shift in the Atlantic ITCZ in coupled models, but an eastward shift in uncoupled models.

This statistical relationship informs three causal hypotheses: i) the north/south shift in the Atlantic ITCZ causes a corresponding north/south shift in the SHL and increase in Sahel precipitation, ii) the location of the Atlantic ITCZ, the location of the SHL, and the strength of Sahel precipitation are all responding to some external forcing, iii) The north/south shift in the SHL causes an increase in Sahel precipitation and a north/south shift in the Atlantic ITCZ. In order to test these hypotheses, three perturbation experiments are performed using the Community Earth System Model (CESM). We find that when the Atlantic ITCZ is forced locally, there is no coherent response in West African climate. However, when the Atlantic ITCZ is forced through altering the cross equatorial energy transport, the SHL and Sahel precipitation respond to the large scale forcing. Similarly, when the SHL strength is forced directly, there is a weak but robust increase in Sahel precipitation and a northward shift in the Atlantic ITCZ.

These experiments show that global scale biases have an important impact on biases local to the West African Monsoon and that there is a feedback from West African climate onto the Atlantic ITCZ.

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